

THE ROLE OF SEASONAL, EDAPHIC AND BIOTIC FACTORS IN THE DEVELOPMENT OF PHYTOPLANKTON COMMUNITIES IN THE CIBAKHÁZA BACKWATER OF THE TISZA

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Abstract

During the three-year seasonal studies carried out in the great backwater of the Tisza at Cibakháza 215 algal taxa were identified. It was found that the formation of algal communities was influenced by seasonal, edaphic and biotic factors. Concerning seasonal distribution of algae, the summer period proved to possess a prime role both qualitatively and quantitatively, with the dominance of climatic and meteorological factors. The community-forming effect of edaphic factors is based on the availability of utilizable and incorporable materials, while that of the biotic ones on "toleration" or "liking" as well as the opposites between synergism and antagonism. Pollution with *fertilizing* organic substances was the principal factor in inducing algal blooms. This also verifies that saprobity and trophity are related with each other not only by the mineralization of organic materials, but also by the selective uptake and utilization of certain organic compounds by certain algae. These considerations basically influence the question of algal indication and are at the same time significant from the aspect of environmental protection, too.

Introduction

Of the backwaters of the Tisza, the so-called "halovány" one at Cibakháza is the greatest, its length being fairly in excess of 20 km. It meanders in irregular U shape on the left bank of the Tisza, and the village Cibakháza is located along its eastern section. Here the sloping shore of the backwater was transformed into a fashionable strand. On the bank opposite to the village an agricultural factory unit was planted. Along the eastern shore line several anglers' camps were established, and in one of them a tablet with the inscription "Feeding Place" was also to be found (this meant the feeding place of fish. This was, however, not real feeding and caused only pollution). These facts are suggestive of the increasing eutrophization of the backwater, and because of this it was considered important to extend studies over the algal flora, algal vegetation, the forms of algal communities in this water body. The algological analyses were performed only in the eastern part of the backwater in the area of the village and its environment. The hazard of pollution with organic materials was here the greatest. The course of the western part of the backwater is only slightly bent and the agricultural environment of the settlement Nagyrév polluted the water here in a lesser degree. The soil of the eastern shore line exhibited signs of sodification, particularly in the flat parts east of the village. There on one occasion the pH of the water was 8.2. In summer and autumn during periods of

collecting, the water was slightly alkaline, with 7.6—7.8 pH values. In the southern section 8.0 pH was measured only on two occasions.

The algal flora and its vegetation forms were analyzed for 3 years. The samples were taken seasonally on the following days: May 30, July 4, October 3, 1976, May 22, August 11, October 26, 1977, May 21, August 4, September 8, 1978. In the table the seasons were marked with letters: a=spring, b=summer, c=autumn. In the allocation of the sampling places the different environmental conditions were also taken into consideration. The constant sampling places were the following ones: 1. The open water at the strand of the village. 2. The open water at the great winding south of the village. 3. The water at the landing stage between the great winding and the village. 4. The open water at the bank opposite to the village. 5. The relatively shallow part of the channel north of the village. Occasionally samples were taken from other places as well. At sampling place 2 the greatest depth of water was approx 4 m. In the section of the channel north of the village, depth of water varied between 0.5 m and 1 m only.

Materials and Methods

The algae were identified in living condition and for the examination of the quantitative relationships of phytoplankton fixed material was used. In these examinations the drop method applied also earlier was used. The course of this procedure was the following: From the sedimented seston of each liter fixed material a concentrate of 10 ml was made. After vehement shaking one drop was taken from this concentrate with a standard pipette for wet preparation the volume of which was 50 mm³ on the average. The quantitative values of each water sample were determined on the basis of 10 wet preparations with 5 grades. The grades 1—5 figure in the seasonal columns (a, b, c) of Table I and their meaning is the following: 1=organism of rare occurrence in the water sample (only 1—5 specimens occurring in the 10 preparations), 2=sporadic occurrence (in 10 preparations only 6—10 individuals were visible), 3=frequent occurrence (there were a few individuals in each preparation), 4=very frequent occurrence (in one preparation numerous, at least 15—20 individuals were found), 5=water bloom with mass production (the water was stained, mostly stained green due to the great number of organisms). This method is still of estimatory value, nevertheless it makes a rather good approximation possible. The first twogrades can be expressed with approximating limits in terms of liter. Because the volume of the drop resp. wet preparation is known, concrete counting beyond the former grades can also be performed by reckoning over into liter. This is, however, very lengthy. In the case of filamentous algae the case is more difficult, since we are compelled to have recourse to appraisal. Estimation is made on the basis of the number of the places of occurrence, the area of extension of the particular population, the extension of the filaments towards depth, and the density of the filaments.

Results and discussion

During the investigations in the backwater at Cibakháza 215 species resp their taxa (variations, forms) were identified. Their distribution according to phyla was the following: Cyanophyta 50, Euglenophyta 27, Chrysophyta 49, Pyrrophyta 8, Chlorophyta 81. The dominance of phylum Chlorophyta in regard of taxons was evident also here as in the majority of backwaters. It was followed by Cyanophyta and Chrysophyta with almost identical taxon numbers. In the latter phylum, Bacillariophyceae had a prime role. In most cases, this proved to be also characteristic of our surface waters.

In the first survey of numerical data, the contribution of Euglenophyta and Pyrrophyta to the phytoplakkton of the backwater seems negligible. We can, howe-

ver, approach the actual situation if the organisms and their communities are analyzed from ecological aspect, i.e. according to the places of occurrence.

Separate presentation of the algal communities of the aforementioned 5 sampling places would have been perhaps better from ecological, physiological aspects. Unfortunately, the space given here does not allow this. The first objective of this study is namely to show the seasonal appearance of the single species and societies. The list presented in Table I is very suitable for this purpose, since it shows clearly the qualitative and quantitative changes of the algal communities according to the different vegetation periods. After this can follow the analysis from edaphic aspect, with the brief characterization of the various potentialities of the different sampling places and their community-forming effect. The seasonal changes in the different places of sampling are namely identical or nearly identical, while the edaphic circumstances of the various sampling places are usually different. Seasonal changes are equally uniformly affected by atmospheric events, since "... the atmosphere is the widest environment producing the most general effects. Its changes usually exert a primary influence on the shaping of the other environmental factors and conditions" (Kiss 1951, 1952).

On the basis of the aforementioned considerations the algal flora of the Cibakháza backwater can be described in the following:

1. The greater species number of algae during summer is generally suggestive of seasonality. This applies particularly to phylum Euglenophyta, the 27 taxa of which could be observed in each sampling place during each summer. Summer populatedness varied from 70% to 90% relative to total algal population. Chrysophyceae classis was a particular exception to this summer "predominance", since its members mostly appeared during spring. A similar phenomenon could be observed also in the Conjugatophyceae classis of green algae. In addition to climatic factors edaphic circumstances were probably also involved in this "liking for spring", since these organisms prefer less polluted waters. During spring the backwater contained less decomposing organic materials. The summer preponderance of seasonality manifested itself not only in qualitative relationships, but in quantitative occurrences, as well. The individual number of each taxon was generally the greatest in summer, and mass productions also occurred in summer. The summer maximum populatedness diminished by autumn, but the presence of algae in autumn was usually in excess of the occurrence of algae in spring both qualitatively and quantitatively. The backwater was characterized by species that occurred in each vegetation period. These were the following ones: *Aphanizomenon flos-aquae*, *Aphanizomenon flos-aquae* var. *Klebahnii*, *Aphanizomenon Issatschenkoi*, *Anabaena solitaria* f. *planctonica*, *Anabaena variabilis*, *Romeria gracilis*, *Oscillatoria tenuis*, *Phormidium luridum*, *Phormidium tinctorium*, *Lyngbya limnetica*, *Caloneis amphibiaena*, *Gomphonema acuminatum*, *Ceratium hirundinella*, *Tetraedron minimum*, *Tetraedron proteiforme*, *Kirchneriella contorta* var. *lunaris*, *Ankistrodesmus angustus*, *Ankistrodesmus falcatus*, *Scenedesmus acuminatus*, *Scenedesmus bicaudatus*, *Scenedesmus denticulatus*, *Crucigenia tetrapedia*, *Crucigenia truncata*, *Cladophora fracta*. *Aulosira fertilissima* and *Characium Sieboldii* of uncertain identification proved to be very rare. During these 3-year studies the could be observed only on one occasion.

2. Water blooms could be observed during three excursions: 4 on July 4, 1976, one on October 3, 1976, and two on August 4, 1978. These algal communities were particular cases in regard of both the edaphic factors and the seasonal ones of the society. Their common feature was that some species of the community exhibited a relatively fast and mass growth and by means of their dominance limited or inhi-

bited the growth of other species. The phenomenon of "accumulation" in time is a characteristic feature of algal mass productions. This accumulation in time means that the numerical increase of algae or the invasion of the increased algal mass takes place in almost the same time. Suitable nutrients and stimulatory substances as the edaphic factors in the water are also likely to be involved in such increases. Of the seasonal factors the favourable atmospheric conditions, in the first approximation mostly the cyclonic-depressed, praefrontal weather may come into consideration. However, their atmospheric physical content is for the most part unknown. The surprising phenomenon of the accumulation of algal mass productions is well-known, and the herdsman in the puszta must have used it in the past for the prognosing of the weather. It also happens even today that we hear a brief, concise popular weather-forecast: "... the water is greening, rain is approaching". This old experience was the starting point of these studies some 50 years ago. It appears that besides the aforementioned seasonal and edaphic factors certain biotic ones are also involved in these mass productions. These factors increase vitality, whereby the algae can take advantage in a greater degree of the conditions of life. In 1925 Rapaics claimed that the phenomenon of water blooms is similar to the increase of bacteria during epidemics (RAPAICS 1925). Increase of vitality may play a role here, too, and in the case of pathogenic bacteria may be perhaps ranged into the category of virulence. I also used the term "virulence" for the designation of the factor group increasing algal vitality in a figurative sense and without its detailed explication (KISS 1951, 1952). The six blooms observed at Cibakháza were the following:

a) In the littoral of the landing stage a massive algal bloom of *Aphanizomenon flos-aquae* was observed on July 4, 1976 which caused the grayish-blueish-green discoloration of the water in a section of about 200 m length and 20—25 m width. In the trichomes of *Aphanizomenon* the cells were mostly considerably constricted at the cross-walls. This may have been an ecotype (1. in Plate I). Associated species of water blooms were also green algae: *Aphanizomenon Issatschenkoi* (6. in Plate I), *Anabaena affinis* (2. in Plate I), *Oscillatoria tenuis* (4. in Plate I), *Oscillatoria sancta* (5. in Plate I), *Trachelomonas granulosa*, *Trachelomonas volvocina*. On October 3, 1976 this water bloom still persisted, extending over areas of even greater extent, but showing signs of disorganization in certain places.

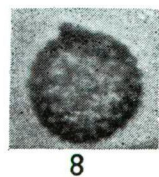
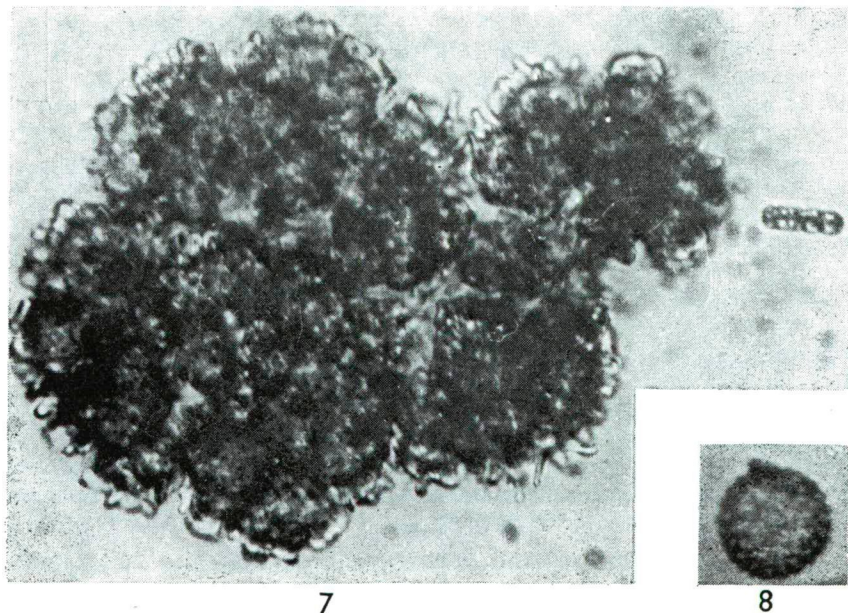
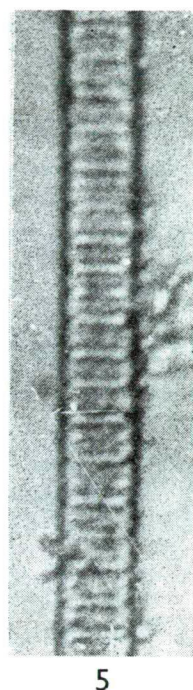
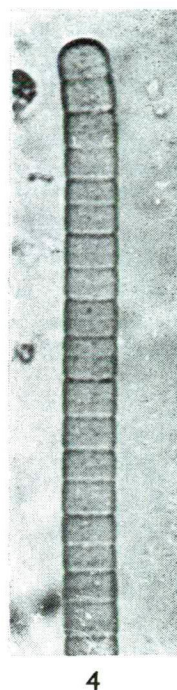
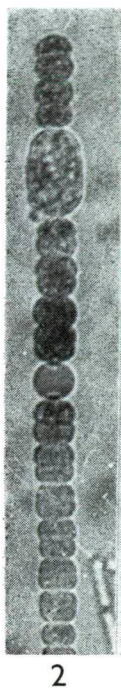
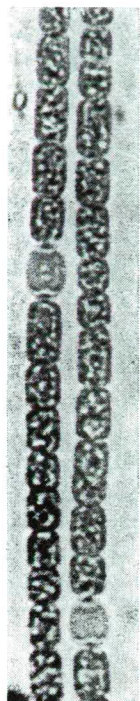
b) The grass green water bloom of *Eudorina elegans* which discolored the water in an area of 20—25 m² on July 4, 1976, was enclosed by this enormous bloom of *Aphanizomenon*. Associated species were: *Oscillatoria planctonica* (3. in Plate I), *Lyngbya limnetica*, *Trachelomonas hispida*, *Cymatopleura solea*, *Pediastrum Boryanum*, and sporadically *Pteromonas angulosa*. It was visible at the boundary line of the two mass productions, that the bloom of *Eudorina* had been of greater extension before, and that at the time of sampling its replacement by the invading *Aphanizomenon* had started. There was no sign of the bloom of *Eudorina* on October 3.

c) On July 4, 1976, at the margin of the village strand in the nearly cut-off

Plate I

1. *Aphanizomenon flos aquae* (L.) RALFS 900:1
2. *Anabaena affinis* LEMM. 1000:1
3. *Oscillatoria planctonica* WOLOSZ. 1000:1
4. *Oscillatoria tenuis* AGARDH 1000:1
5. *Oscillatoria sancta* (KÜTZ.) GOM. 700:1
6. *Aphanizomenon Issatschenkoi* (USSACZEW) PROSCHKINA-LAWRENKO 400:1
7. *Phormidium mucicola* HUBER-PASTALOZZI et NAUMANN 600:1
8. *Coelosphaerium Keutzingianum* NÄGELI 500:1

Plate I



shallow water, the bloom of *Chlamydomonas multitaeniata* produced a spotted, light grass green discoloration of water. The bioeston sedimented on the substrate previously was just in the state of swarming. Associated species were: *Coelosphaerium Kuetzingianum* (8. in Plate I), *Cyclotella Meneghiniana*, *Asterionalla formosa*, *Pandorina charkowiensis*, *Pandorina morum*, *Selenastrum Bibrainum*, *Pediastrum Boryanum*.

d) In the same period, the littoral of the backwater opposite to the village as well as the open water there in a section of 70—80 m length and 15—20 m width possessed a grass-green colour. The water bloom was produced by *Euglena polymorpha*. Here the littoral must have been polluted earlier with organic fertilizing substances. Associated species were: *Trachelomonas Dybowskii*, *Trachelomonas hispida*, *Trachelomonas scabra*.

(e) During summer, 1978, *Euglena polymorpha* produced a mass production in the former place. On August 4, only the littoral became green in colour. Here, too, organic fertilizing substances must have got into the water. Associated species were the following: *Trachelomonas scabra*, *Trachelomonas volvocina*, *Cymatopleura solea*, *Tetradron proteiforme*, *Scenedesmus acuminatus*, *Pediastrum biradiatum*.

(f) On August 4, 1978, the light green mass production of *Kirchneriella contorta* var. *lunaris* was observed in a shallow dip of the littoral opposite to the village. The cells smaller than normal were often broken up into particles of 1—2 μm diameter. Associated species were the following: *Cymbella affinis*, *Oocystis cingulatus*, *Scenedesmus ecoris*.

3. The appearance of *Phormidium mucicola* in the communities was novel. Its trichomes were imbedded into the entangled mass of 3-celled hormogoniums of *Aphanizomenon flos-aquae*. The great mass seen in photo 7 of Table I consists of at least 5—6 hormogonium masses and at the peripheries of the hormogonium masses the trichomes of *Phormidium* extending in the form of thin filaments are seen. At the right side margin of the picture one short hormogonium of *Aphanizomenon* is visible. This associations was particularly frequent in the bloom of *Aphanizomenon* in summer and autumn 1976. The water was covered in places by a thick syrup-like mass and the surface of that formed gradually a thin film as a consequence of evaporation. It could be observed in samples taken from that film that the clustered hormogoniums surrounded the small trichomes of *Phormidium*. This mechanism may be explained by the coagulation of the colloidal mucilaginous sheath. In the presence of iron (Fe^{+++}) cations coagulation can take place very quickly, particularly in dry weather.

4. From edaphic aspect, the two blooms of *Euglena polymorpha* in the backwater of Cibakháza were signs suggesting that pollution with fertilizing organic materials plays an important rôle in eutrophication. Since the thirties it has been often observed that in waters polluted with fertilizing organic materials or decomposing organic substances, enormous blooms of species belonging to Euglenophyta can occur (KISS 1939, 1951, 1952, 1970, 1976). In the sea at the point of inflow of the sewer of the Finnish metropolis and in the brackish water under the ice cover of the sea VÄLIKANGAS (1922) observed the great mass production of *Euglena viridis*. It is essential from the point of view of biotic factors that the associated species of the water blooms in the backwater at Cibakháza exhibited a rather great tolerance and the algae occurring concurrently in great numbers in the same place call our attention to the possibilities of synergism. *Aphanizomenon flos-aquae*, the bloom of which inhibited and later stopped the mass production of *Eudorina elegans* was an example of open antagonism. The antagonism between these two species was observed also

Table I

No	Species (taxon)	1976			1977			1978		
		a	b	c	a	b	c	a	b	c
Phylum: Cyanophyta										
1.	<i>Microcystis flos aquae</i> (WITTR.) KIRCHN.	1	3	2		2			3	2
2.	<i>Gomphosphaeria aponina</i> KÜTZ.		2	1		1	1		2	
3.	<i>Coelosphaerium Kuetzingianum</i> NÄGELI		3		1	2		1	2	1
4.	<i>C. Naegelianum</i> UNGER		2	1		1				
5.	<i>Merismopedia glauca</i> (EHR.) NÄGELI		1		1	2				
6.	<i>Dactylococcopsis raphidioides</i> HANSG.	1	2	2	1	2	2		1	
7.	? <i>Aulosira fertilissima</i> GHOSE						1			
8.	<i>Aphanizomenon flos-aquae</i> (L. RALFS	2	5	5	1	2	4	3	4	4
9.	<i>A. flos-aquae</i> var. <i>Klebahnii</i> ELENKIN	1	3	3	2	3	3	2	3	3
10.	<i>A. flos-aquae</i> f. <i>gracile</i> (LEMM.) ELENK.		2	2		2		1		
11.	<i>A. Issatschenkoi</i> (USSACZ.) PROSCHK. LAVR.	2	3	1	1	3	1	1	2	1
12.	<i>Anabaena aphanizomenoides</i> FORTI		2		1	2	1	1		
13.	<i>A. affinis</i> LEMMERMANN		3	2			2	1		
14.	<i>A. solitaria</i> f. <i>planctonica</i> (BRUNNTH.) KOMÁREK	1	2	2	1	1	3	1	1	1
15.	<i>A. spiroides</i> KLEBAHN		3			4	1		3	2
16.	<i>A. variabilis</i> KÜTZING	1	2	1	1	3	2	1	2	2
17.	<i>A. variabilis</i> f. <i>crassa</i> WORONICHIN		1	1	1	2				
18.	<i>Romeria gracilis</i> KOCZWARA	1	2	2	1	3	1	1	2	1
19.	<i>R. leopoliensis</i> (RACIBORSKI) KOCZWARA		1	1		2	1	1	2	
20.	<i>Spirulina laxissima</i> G. S. WEST		2	1		3	2		2	1
21.	<i>Oscillatoria acutissima</i> KUFFERAT		2		1	2	1		1	
22.	<i>O. angustissima</i> W. et G. S. WEST	1	2			2	1			
23.	<i>O. deflexa</i> W. et G. S. WEST		2	2			3			
24.	<i>O. Lauterbornii</i> SCHMIDLE			3			1		1	
25.	<i>O. Lemmermannii</i> WOŁOSZYNSKA	2	1	1		1	1	1	1	
26.	<i>O. limnetica</i> LEMMERMANN	1	3		1	2		2		
27.	<i>O. minima</i> GICKLHORN		2				1	1	1	
28.	<i>O. pseudogeminata</i> G. SCHMID		1				2	2		
29.	<i>O. planctonica</i> WOŁOSZYNSKA	1	2	2	1	3	1	1	2	2
30.	<i>O. subtilissima</i> KÜTZING		2	2		3	1	1	1	1
31.	<i>O. sancta</i> (KÜTZ.) GOMONT	1	4	2	1	2		2		
32.	<i>O. tenuis</i> AGARDH	1	2	3	1	3	1	1	2	1
33.	<i>O. trichoides</i> SZAFER		3	1		3	2		2	
34.	<i>Phormidium corium</i> (AGARDH) GOMONT	1	2	2	1	2	2		2	
35.	<i>Ph. foveolarum</i> (MONTAGNE) GOMONT		3	1		2				
36.	<i>Ph. incrustatum</i> (NÄGELI) GOMONT		2	2		1			2	
37.	<i>Ph. luridum</i> (KÜTZ.) GOMONT	1	2	2	1	1	1	1	2	1
38.	<i>Phormidium molle</i> (KÜTZ.) GOMONT		2		1	3	1	1	2	1
39.	<i>Ph. mucicola</i> HUBER—PESTALOZZI et NAUMANN		3	1		2	2		2	1
40.	<i>Ph. purpurascens</i> (KÜTZ.) GOMONT	1	3	1	1	1		1	2	1
41.	<i>Ph. tenue</i> (MENEGHINI) GOMONT		1			1	1		1	
42.	<i>Ph. tinctorium</i> KÜTZING	2	3	2	2	3	1	1	1	1
43.	<i>Lyngbya bipunctata</i> LEMMERMANN		2	1		1			1	
44.	<i>L. endophytica</i> ELENKIN et HOLLERBACH		3				1			
45.	<i>L. Hieronymusii</i> LEMMERMANN	1	2			1		1	1	
46.	<i>L. Lagerheimii</i> (MÖBIUS) GOMONT			2		1	1			
47.	<i>L. limnetica</i> LEMMERMANN	1	2	2	1	2	1	1	2	1
48.	<i>L. lutea</i> (AGARDH) GOMONT		1	1		1	1		1	1
49.	? <i>L. mucicola</i> LEMMERMANN		2			1				
50.	<i>L. putealis</i> MONTAGNE			1		1	1		2	1
Phylum: Euglenophyta										
1.	<i>Euglena acus</i> EHRENBERG	1	2	1		1			1	1
2.	<i>E. Ehrenbergii</i> KLEBS		3			2			2	1
3.	<i>E. limnophila</i> LEMM.		2			2	1		1	

No	Species (taxon)	1976			1977			1978		
		a	b	c	a	b	c	a	b	c
4.	<i>E. oxyuris</i> var. <i>minor</i> DEFLANDRE	1	2	1		2	1		1	1
5.	<i>E. pisciformis</i> KLEBS		2	1		1			1	
6.	<i>E. polymorpha</i> DANGEARD		5	2		3	1		5	1
7.	<i>E. proxima</i> DANGEARD		3	1		1	1		2	1
8.	<i>E. thinophila</i> SKUJA		2			1			2	
9.	<i>Lepocinclis fusiformis</i> (CARTER) LEMM.		3	2		2			2	
10.	<i>L. ovum</i> (EHR.) LEMM.		2	1		1			2	1
11.	<i>L. teres</i> (SCHMITZ) FRANCÉ		1	1		2	1		1	
12.	<i>L. texta</i> (DUJARDIN) LEMMERMANN	1	2	1	1	1	1		1	
13.	<i>Phacus acuminatus</i> STOKES	1	1	1		2	1		1	1
14.	<i>Ph. caudatus</i> HÜBNER		2			2	1		2	
15.	<i>Trachelomonas crebea</i> KELLICOTT		2	1		2	1		2	
16.	<i>Tr. Dybowskii</i> DREZEPOLSKI		2	1		1	1		1	
17.	<i>Tr. granulosa</i> PLAYFAIR		1			2			1	1
18.	<i>Tr. hispida</i> (PERTY) STEIN		1			1			2	
19.	<i>Tr. hispida</i> var. <i>crenulatoecollis</i> f. <i>recta</i> DEFL.		2	1		1	1		2	
20.	<i>Tr. intermedia</i> DANGEARD		2			3	2		2	1
21.	<i>Tr. Lefevrei</i> DEFLANDRE		2			2		1	1	
22.	<i>Tr. oblonga</i> var. <i>truncata</i> LEMM.		1			1	1		2	
23.	<i>Tr. scabra</i> PLAYFAIR		2	2	1	2	1	1	2	1
24.	<i>Tr. volvocina</i> EHRENBURG		2	1		1			1	
25.	<i>Tr. volvocina</i> var. <i>derephora</i> CONRAD	1	1	1		2			2	1
26.	<i>Strombomonas Deflandrei</i> (ROLL) DEFL.		3	2		2	1		1	1
27.	<i>Str. verrucosa</i> var. <i>zmiewika</i> DEFL.	1	2	1		3	1		1	
Phylum: Chrysophyta										
Classis: Xanthophyceae										
1.	<i>Characiopsis minor</i> PASCHER		1				2			
2.	<i>Centritractus belonophorus</i> LEMMERMANN		1	1		1	1		1	
3.	<i>C. dubius</i> PRINTZ	1	1		2			1		
4.	<i>Ophiocytium capitatum</i> WOLLE	1			1					
5.	<i>Tribonema monochloron</i> PASCHER et GEITLER		2		1	1			1	
6.	<i>Tribonema</i> spec.	1	2							
7.	<i>Vaucheria</i> spec.		2	1		3	1		2	
Classis: Chrysophyceae										
8.	<i>Chrysococcus ornatus</i> PASCHER	1	1		1			1		
9.	<i>Chrysoglena verrucosa</i> WISL.	1			1			1		
10.	<i>Bicoeca planctonica</i> KISSELEW	1	2			1		1		
11.	<i>Dinobryon divergens</i> IMHOF	1	2		2	2		1	2	
Classis: Bacillariophyceae										
12.	<i>Melosira granulata</i> var. <i>muzzanensis</i> (MEISTER) BETHE	1	1			1		1		
13.	<i>M. varians</i> C. A. AG.		1			1				
14.	<i>Cyclotella compta</i> (EHR.) KÜTZ.	2	1		2			1	1	
15.	<i>C. Meneghiniana</i> KÜTZING		2	2	1	2	1	1	2	2
16.	<i>Diatoma vulgare</i> BORY		1	1		1		1		
17.	<i>Fragilaria capucina</i> DESMAZIERES			1		2				
18.	<i>Asterionella formosa</i> HASSALL		3	1		1	1		1	1
19.	<i>Synedra acus</i> (KÜTZ.) HUSTEDT		1	2		2			1	
20.	<i>Eunotia praerupta</i> var. <i>inflata</i> GRUNOV	1	2	1		1	1	1	1	1
21.	<i>Cocconeis placentula</i> var. <i>euglypta</i> (EHR.) CLEVE	1	1	1		1		1	1	
22.	<i>Caloneis amphisbaena</i> (BORY) CLEVE	1	1	1	1	1	1	1	1	1
23.	<i>Navicula cincta</i> (EHR.) KÜTZ.		2	1			2			1
24.	<i>N. cryptocephala</i> KÜTZING		1	1		1	1		1	
25.	<i>N. cryptocephala</i> var. <i>venata</i> (KÜTZ.) GRUN.		2	2		1			1	
26.	<i>N. gregaria</i> DONKIN		2	1		2			1	

No	Species (taxon)	1976			1977			1978		
		a	b	c	a	b	c	a	b	c
27.	<i>N. lanceolata</i> (AGARDH) KÜTZING	1	1			1			1	
28.	<i>N. menisculus</i> var. <i>meniscus</i> ACHUMANN		2	1			1			
29.	<i>Amphora commutata</i> GRUNOW		1	1		2		1	1	1
30.	<i>A. normani</i> RABENHORST		2	1	1	1	1	1	2	
31.	<i>A. ovalis</i> KÜTZING	1	1			1	1		1	1
32.	<i>A. venata</i> KÜTZING		1		1	1	1		1	1
33.	<i>Cymbella affinis</i> KÜTZING		2	2		1	2		2	2
34.	<i>C. cymbiformis</i> (KÜTZ.) v. HEURCK		1			1	1		1	
35.	<i>C. cystula</i> (HEMPRICH) GRUNOW	1	1		1	1			1	1
36.	<i>C. cystula</i> var. <i>maculata</i> (KÜTZ.) v. HEURCK	1	1			1		1	1	
37.	<i>C. prostrata</i> (BERKELEY) CLEVE		2	1		1			1	
38.	<i>C. ventricosa</i> KÜTZING			1		1				
39.	<i>Gomphonema acuminatum</i> EHRENBERG	1	3	2	1	2	1	1	2	2
40.	<i>G. acuminatum</i> var. <i>trigonocephala</i> (EHR.) GRUN.		1				1		1	1
41.	<i>G. augur</i> EHRENBERG		2	1		2		1	2	1
42.	<i>G. constrictum</i> var. <i>capitata</i> (EHR.) CLEVE		2			1				
43.	<i>G. olivaceum</i> (LYNGBYE) KÜTZING		1			1				
44.	<i>G. parvulum</i> var. <i>subelliptica</i> CLEVE			1		2	1		1	
45.	<i>G. tergestinum</i> (GRUN.) FRICKE					1			1	
46.	<i>Epithemia zebra</i> var. <i>porcellus</i> (KG.) GRUN.		1					1	2	1
47.	<i>Nitzschia capitellata</i> HUSTEDT		2				1			
48.	<i>N. palea</i> (KÜTZ.) W. SMITH			1		1	1		1	
49.	<i>Cymatopleura solea</i> (BRÉB.) W. SMITH		1			1			1	1
Phylum: Pyrrophyta										
1.	<i>Cryptomonas</i> spec.	1			1					
2.	<i>Gymnodinium rotundatum</i> KLEBS				1	1		1		
3.	<i>Glenodinium edax</i> SCHLLING				1					
4.	<i>G. pulvisculus</i> (EHR.) STEIN	1	1			1		1	1	
5.	<i>Peridinium aciculiferum</i> (LEMM.) LEMM.		2			1				
6.	<i>P. cinctum</i> (O. F. M.) EHR.	1	1	1		1		1		
7.	<i>P. palatinum</i> LAUTERB.		2	1		1	1	1	1	1
8.	<i>Ceratium hirundinella</i> (O. F. MÜLLER) SCHRANK	1	4	2	1	3	1	2	4	1
Phylum: Chlorophyta										
Classis: Chlorophyceae										
Ordo: Volvocales										
1.	<i>Chlamydomonas multitaeniata</i> KORS.		5	1		2		2		
2.	<i>Pteromonas angulosa</i> LEMMERMANN	1	2		2	3		2	2	
3.	<i>Pandorina morum</i> (MÜLLER) BORY		2			2	1	1	2	
4.	<i>P. charkoviensis</i> KORS.		3	1		3	1	1	2	
5.	<i>Eudorina elegans</i> EHR.	1	5	2		2		1	2	
Ordo: Chlorococcales										
6.	<i>Tetradron caudatum</i> (CORDA) HANS GIRG		2	1		2	1		3	1
7.	<i>T. caudatum</i> var. <i>punctatum</i> LAGERHEIM		1			1	2		1	
8.	<i>T. incus</i> (TEIL) G. M. SM.			1		2	1		1	1
9.	<i>T. minimum</i> (A. BRAUN) HANS GIRG	1	2	2	1	3	1	1	3	1
10.	<i>T. minimum</i> var. <i>apiculatum</i> REINSCH		1	1		2	1		1	1
11.	<i>T. muticum</i> (A. BRAUN) HANS GIRG		3	3		2	3	1	3	1
12.	<i>T. proteiforme</i> (TURN.) BRUNNTH.	1	1	2	1	2	1	1	2	1
13.	<i>T. triangulare</i> KORS.		1			1	1		1	1
14.	<i>T. trigonum</i> (NÄG.) HANS GIRG	1	1			1	2	1	1	1
15.	<i>Characium Braunii</i> BRÜGG.		2			1	1		2	1
16.	<i>Ch. ensiforme</i> HERMANN				1	1	1		1	
17.	<i>Ch. Naegeli</i> A. BRAUN	1	1	1		1	1			1
18.	<i>Ch. Sieboldii</i> A. BRAUN			1						

No	Species (taxon)	1976			1977			1978		
		a	b	c	a	b	c	a	b	c
19.	<i>Oocystis cingulatus</i> HORTOB. et NÉMETH		2			1	1	1	1	
20.	<i>O. Marssonii</i> LEMMERMANN			1		1	1			1
21.	<i>O. natans</i> (LEMM.) LEMM.	1			1	1		1		
22.	<i>Chodatella maxima</i> HORTOB.					1			2	2
23.	<i>Coenocystis planctonica</i> KORSIKOV	2	1	3		2			2	1
24.	<i>Lagerheimia Griffithsii</i> FOTT						1		1	
25.	<i>Franceia Driescherii</i> (LEMM.) KORS.		1			1	1			
26.	<i>Chodatellopsis elliptica</i> KORSIKOV							1	1	
27.	<i>Nephrochlamys allanthoidea</i> KORSIKOV	1				1	1		1	
28.	<i>Nephrocytium Agardhianum</i> NÄG.		2		1					1
29.	<i>N. limneticum</i> (G. M. SM.) SKUJA			2					2	1
30.	<i>N. varium</i> HORTOB.					1		1		
31.	<i>Kirchneriella contorta</i> (SCHMIDLE) BOHL.		1			1	1		1	1
32.	<i>K. contorta</i> var. <i>lunaris</i> RICH.	1	1	1	1	2	2	2	5	3
33.	<i>K. lunaris</i> (KIRCHN.) MÖB.		2	2		1	2		2	2
34.	<i>Selenastrum Bibraianum</i> REINSCH		1	1		2	3		3	3
35.	<i>Ankistrodesmus angustus</i> BERN.	1	1	1	1	1	2	2	3	3
36.	<i>A. arcuatus</i> KORSIKOV		2	2		1			2	2
37.	<i>A. falcatus</i> (CORDA) RALFS	1	2	2	1	2	2	1	2	2
38.	<i>A. pseudomirabilis</i> KORSIKOV		2	1		3	1		3	1
39.	<i>Coenocystis reniformis</i> KORSIKOV		1		2	1	1	1	4	1
40.	<i>Micractinium pusillum</i> FRESEN	2	1		1					
41.	<i>M. quadrisetum</i> (LEMM. G. M. SM.				1	2			1	
42.	<i>Dictyosphaerium pulchellum</i> WOOD		2			1		1	2	1
43.	<i>Didymocystis bicellularis</i> (CHODAT) KOMAREK					1			2	1
44.	<i>D. inermis</i> (FOTT) FOTT				1			1	1	
45.	<i>Coelastrum microporum</i> NÄGELI	1	2	1		1	1		2	1
46.	<i>C. pseudomicroporum</i> KORSIKOV		1		1	3	1	1	2	1
47.	<i>C. sphaericum</i> NÄGELI		1	1		2	1		1	1
48.	<i>Scenedesmus acuminatus</i> (LAGERH.) CHODAT	1	2	1	2	3	2	1	3	1
49.	<i>Sc. acuminatus</i> var. <i>bernardii</i> (G. M. SM.) DEDUSS.		1	1		1	1		1	1
50.	<i>Sc. acutus</i> MEYEN		2	1		3	1		2	2
51.	<i>Sc. acutus</i> f. <i>costulatus</i> (CHOD.) UHERKOV.		1			2			1	1
52.	<i>Sc. apiculatus</i> (W. et G. S. WEST) CHODAT					1				
53.	<i>Sc. bicaudatus</i> (HANS G.) CHODAT	1	1	1	1	2	2	1	1	1
54.	<i>Sc. brevispina</i> (G. M. SMITH) CHOD.					2	1		1	
55.	<i>Sc. denticulatus</i> LAGERHEIM	1	2	2	1	3	2	1	3	2
56.	<i>Sc. dispar</i> BRÉB.		1			2	1		1	1
57.	<i>Sc. eornis</i> (RALFS) CHODAT		2	1		3	1		2	1
58.	<i>Sc. eornis</i> var. <i>disciformis</i> CHODAT		1	1	1	2	1		2	1
59.	<i>Sc. regularis</i> SWIR.		1	1		2	2	1	3	2
60.	<i>Sc. quadricauda</i> (TURP.) BRÉB.					2	2	1	1	1
61.	<i>Crucigenia apiculata</i> (LEMM.) SCHMIDLE		1	1		3	2		2	1
62.	<i>Cr. rectangularis</i> (NÄGELI) GAY		1			1	1		1	1
63.	<i>Cr. tetrapedia</i> (KIRCHN.) W. et G. S. WEST	1	2	1	2	2	1	1	3	2
64.	<i>Cr. truncata</i> G. M. SM.	1	1	1	1	1	1	1	2	1
65.	<i>Tetrastrum staurogeniaeforme</i> (SCHRÖD.) LEMM.	1	2	1		2	1		2	1
66.	<i>T. staurogeniaeforme</i> f. <i>exaltatum</i> HORTOB.					1			1	
67.	<i>Actinastrum Hantzschii</i> var. <i>fluvialitidis</i> SCHRÖD.		1	1		2	1	1	1	1
68.	<i>Pediastrum biradiatum</i> MEYEN					1		1	1	
69.	<i>P. Boryanum</i> (TURP.) MEMEGH.		2	1	1	2			2	1
70.	<i>P. Boryanum</i> var. <i>longicorne</i> REINSCH		1			1	2	1	2	2
71.	<i>P. simplex</i> f. <i>duodenarium</i> (BAILEY) LEMM.					1			1	
Ordo: Ulothrichales, Siphonocladales										
72.	<i>Geminella interrupta</i> (TURP.) LAGERH.								1	2
73.	<i>G. ordinata</i> (W. u. G. S. WEST) HEERING					1	2			

No	Species (taxon)	1976			1977			1978		
		a	b	c	a	b	c	a	b	c
74.	<i>Hormidiopsis</i> spec.		1	1		1	2		2	1
75.	<i>Cladophora fracta</i> KÜTZ. ampl. BRAND	2	3	3	2	3	3	3	4	3
	Classis: Conjugatophyceae									
76.	<i>Closterium ceratium</i> PERTY				1			1	2	
77.	<i>Cosmarium granatum</i> BRÉB.		1		1	2		1	2	
78.	<i>C. humile</i> (GAY.) NORDST.							1	1	
79.	<i>Straurastrum gracile</i> RALFS				1	1				
80.	<i>St. paradoxum</i> MEYEN				1	1		1		
81.	<i>Mougeotia virescens</i> (HASSALL) BORGE		2			3			2	

in 1935 (Kiss 1939). Only the related Cyanophyta species exhibited certain tolerance of the aggressivity of *Aphanizomenon*.

5. It is seen from the foregoing that the algae can well utilize organic materials. This is very important from the view of environmental protection. Certain groups of algae, species, moreover smaller physiological-biochemical units within the species are able to utilize also selectively and directly certain amino acids, carbohydrates, vitamins, plant hormones and other organic materials. Thus, saprobity and trophity are related with each other not only because the organic materials involved in the saprobity process increase trophity by their mineralization but also because the algae are able to incorporate some of these substances. This is of great significance in regard of algal indication.

Further studies are necessary in connection with the varied algal flora of the backwaters of the Tisza. In the beginning only some details of the algal flora were studied (PÁKH 1933, SZABADOS 1938, 1940). Hortobágyi was the first to perform a detailed explorative work, establishing the presence of 273 algal taxa in the Nagyfa backwater which is located near to Szeged (HORTOBÁGYI 1939). He complemented his results with further investigations, moreover, found also a marine brackish water algal species in the Nagyfa backwater, which in his opinion must have been introduced there by migrating birds (HORTOBÁGYI 1941a, 1941b, 1942). The first algological researches extended on the whole Hungarian section of the Tisza river were performed by UHERKOVICH (1971). He studied the algae of the Tisza in the saprobiontic system, the new and rare algal species of the Tisza and the algal flora of several backwaters both qualitatively and quantitatively (UHERKOVICH 1959, 1961a, 1961b, 1963, 1967a, 1967b, 1971). Exploratory research work was carried out by Kiss in connection with the algal flora of some backwaters (KISS 1975, 1977a, 1977b, 1978a, 1978b, 1979). It would be both timely and useful from the aspect of basic research and environmental protection to perform comparative studies concerning the algae of the Tisza river, its backwaters and its tributaries.

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Szezonális, edáfikus és biotikus tényezők szerepe a cibakházai holtág algaflaúrásiáinak kialakulásában

Kiss I.

Tiszakutató Munkacsoport Szeged, Magyarország

Kivonat

Az értekezés a Cibakháza melletti Holt-Tiszából összesen 215 algataxont közöl. A 3 éven át folytatott munka az algaflaúrásiáinak kialakulásának szezonális, edáfikus és biotikus tényezőinek feltárására is irányult. A táblázat szerint az algavilág kvalitatív és kvantitatív szempontból nyáron a leggazdagabb. Az edáfikus tényezők flaúrásiáformáló hatása a felvehető és testbe építhető anyagokon alapszik, a biotikus tényezők pedig a „túrás” és „kedvelés”, valamint a szinergizmus és antagonizmus ellentéteiből adódnak. A vízvírágázások kialakulásában a szervestrágyával való nyézódás a legdöntőbb, s rámutat: a szaprobitás és a trofitás nemcsak a szervesanyagok mineralizálódásával függnek össze, hanem úgy is, hogy az algák szelektív módon organikus vegyületeket is hasznosítanak. Ez az alga-indikáció kérdését alapjaiban érinti, s ezen keresztül igen jelentős a környezetvédelem szempontjából is.

Uticađ sezonskih, edafskih i biotičkih faktora na razvoj zajednica algi u mrtvaji Cibakháza

Kiss I.

Radna grupa za istraživanje reke Tise, Szeged, Hungaria

Abstrakt

U radu je ukupno prikazano 215 taksona algi iz mrtve Tise kod Cibakháza. Torgodišnji rad ukazuje i na uticaj sezonskih, edafskih i biotičkih faktora na razvoj zajednica algi. Svet algi je najbogatiji kako u kvalitativnom tako i u kvantitativnom pogledu u toku leta. Uticaj edafskih faktora na formiranje zajednice se zasniva na materijama koje se mogu uzimati i ugraditi u telo. Biotički faktori se javljaju u smislu podnošljivosti, a takodje proizilaze i iz suprotnosti sinergizma i antagonizma. Zagadjivanje organskim đubrivima je najodlučujući faktor u pojavljivanju cvetanja vode i ukazuje na činjenicu da saprobnost i trofičnost nije u zavisnosti samo od mineralizacije organskih materija, već i od činjenice da alge selektivnim putem koriste i organska jedinjenja. Ova činjenica u osnovi zadire i u pitanje algi kao indikatora, i od značaja je i u pogledu zaštite životne sredine.

РОЛЬ СЕЗОННЫХ, ЭДАФИЧЕСКИХ И БИОЛОГИЧЕСКИХ ФАКТОРОВ ПРИ ФОРМИРОВАНИИ ВОДОРΟΣЛЕВЫХ СООБЩЕСТВ В ЦИБАКХАЗСКОЙ СТАРИЦЕ

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Резюме

В работе описаны 215 таксонов водорослей из старицы Тисы расположенной вблизи С. Цибакхаза. В течении 3-х лет направление работы велось на раскрытие сезонных, эдафических, биотических факторов образований водорослевых сообществ.

Приведенные в таблице данные показывают на то, что мир водорослей, как и качественно-но являются самым большим богатством этого места летом. Влияние эдафических факторов

при образовании сообществ водорослей закладывается на основании образующихся веществ в организме водорослей, а биотические факторы закладываются на «терпении» и «желании», а также на синергизме и антагонизме. При формировании цветения воды, наиболее решающим является загрязнение воды органическими удобрениями, что говорит о том, что сапрофитизм и трофитизм зависимы не только от минерализации органических веществ, но и о том, что водоросли путем селективных обособленностей используют и органические соединения. Это, в основном, касается вопросов индикаторов водорослей, что является очень важным моментом с точки зрения охраны природы.